

What is claimed is:

1. A method of generating mask data for a set of masks used to transfer a pattern for delineating a circuit pattern of a semiconductor integrated circuit, the method comprising:

5        preparing design data having a design pattern corresponding to the pattern to be transferred on a semiconductor substrate;

         generating resized data by enlarging the design data by a resizing quantity;

         generating first mask data by filling a space area having a space width of a space quantity or less of the resized data; and

10        generating second mask data, to be aligned with the first mask data, having a window portion for selectively exposing an area determined by enlarging the space area by the resizing quantity.

2. The method of claim 1, wherein the resizing quantity is larger than a half value of  
15        a difference, between a minimum line width with which a pattern can be optically resolved by the projection exposure system and a line width of the design pattern.

3. The method of claim 1, wherein the space quantity is larger than the minimum  
20        space width with which a pattern can be optically resolved by the projection exposure system.

4. The method of claim 1, further comprising performing optical proximity correction on the first and second mask data respectively.

25        5. The method of claim 1, further comprising:

         estimating a space width reducing quantity for reducing a space width, of

the pattern to be transferred on the semiconductor substrate, determined by the window portion; and

enlarging the window portion by the space width reducing quantity.

5 6. The method of claim 1, further comprising performing process proximity correction on the first and second mask data to prevent process proximity effect in a process for reducing a space width of the pattern to be transferred on the semiconductor substrate.

10 7. The method of claim 1, wherein preparing the design data comprises:  
estimating a space width reducing quantity for reducing a space width, of the pattern to be transferred on the semiconductor substrate, determined by the window portion; and

preparing the design data having a minimum space width with which a  
15 pattern can be optically resolved by the projection exposure system or less.

8. A method for forming a pattern comprising:

depositing a process-target film on a semiconductor substrate;

depositing an underlying mask film on the process-target film;

20 delineating a first resist film on the underlying mask film;

delineating a first resist pattern by transferring a pattern of a first mask onto the first resist film;

delineating an underlying mask pattern having narrower line width than a line width of the first resist pattern by removing a part of the underlying mask film;

25 delineating a second resist film on the underlying mask pattern;

delineating a second resist pattern having a window portion for exposing a

part of the underlying mask pattern, by transferring a pattern of a second mask onto the second resist film; and

removing a part of the underlying mask pattern selectively, using the second resist pattern as an etching mask.

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9. The method of claim 8, wherein forming the underlying mask pattern comprises:

forming a resized resist pattern by slimming the first resist pattern;

removing a part of the underlying mask film selectively, using the resized resist pattern as an etching mask; and

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removing the resized resist pattern.

10. The method of claim 8, wherein forming the underlying mask pattern comprises:

forming a resized resist pattern by slimming the first resist pattern, and

forming the underlying mask pattern by removing a part of the underlying mask

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film selectively at the same time; and

removing the resized resist pattern.

11. The method of claim 8, wherein forming the underlying mask pattern comprises;

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forming a pattern of the underlying mask film by removing a part of the underlying mask film selectively with the first resist pattern as an etching mask;

removing the first resist pattern; and

forming the underlying mask pattern by slimming the pattern of the underlying mask film.

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12. The method of claim 8, further comprising removing a part of the

process-target film, using the underlying mask pattern which a part thereof is selectively removed as an etching mask.

13. The method of claim 8, further comprising reducing the window portion  
5 of the second resist pattern by a thermal process so as to have a smaller size than a minimum space width with which a pattern can be optically resolved by a projection exposure system, between the forming of the second resist pattern and the removing of a part of the underlying mask pattern.

10 14. The method of claim 8, further comprising, between the forming of the second resist pattern and the removing of a part of the underlying mask pattern:

depositing an over-coat film on the second resist pattern;

forming a mixed layer covering a part of the window portion of the second  
15 resist pattern by mixing a part of the second resist pattern and a part of the over-coat film by thermal process; and

removing the over-coat film.

15. The method of claim 14, wherein the removing of a part of the underlying mask  
20 pattern removes a part of the underlying mask pattern, using the second resist pattern and the mixed layer as etching masks.

16. The method of claim 8, further comprising depositing an auxiliary underlying  
mask film on the process-target film having a higher etching rate than etching rate  
25 of the underlying mask film, between the depositing of the process-target film and the depositing of the underlying mask film.

17. The method of claim 16, further comprising removing a part of the auxiliary underlying mask film, using the underlying mask pattern which a part thereof is selectively removed as an etching mask.

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18. The method of claim 8, further comprising depositing a first antireflection film on the process-target film, between the depositing of the underlying mask film and the forming of the first resist film.

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19. The method of claim 8, further comprising depositing a second antireflection film on the first resist film, between the forming of the first resist film and the forming of the first resist pattern.

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20. A set of masks for forming thin line portion having a line width thinner than a minimum line width which can be optically resolved by a projection exposure system by slimming a line width of a pattern transferred on a semiconductor substrate, the set of masks comprising:

a first mask having the thin line pattern for forming the thin line portion;

and

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a second mask having a window portion for removing an unnecessary portion from a pattern transferred by the first mask.